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Abstract

APPLICATION OF DIGITAL-COMPUTER TECHNIQUES TO REACTOR OPERATIONS

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Over fifty digital-computer-controlled conventional power plants have been started in the U. S. A. The same economic reasons that have led to the selection of computers for control of fossil-fueled power plants should ultimately prevail for nuclear power installations. No completely digitized nuclear control system has yet been installed in the U. S. A., but several plants use digital computers as data-acquisition devices as a preliminary step toward actual control. This paper compares the existing installations, projects the future trends and describes some of the specialized digital control components and techniques at present in use and under development. It includes a philosophic discussion on the role the computer can play in the nuclear power field; safety, reliability and operator-interaction problems of proposed digital control systems are developed.

Studies have been performed by IBM, Daystrom, Ford, Aerojet and others which indicate that the function of the computer can profitably and reliably be extended. Five functions have been projected by these studies as being feasible for nuclear plants. The first function is data logging and alarming. Digital data logging is, or has been, installed at Shippingport, Hanford, General Electric - Nuclear Materials and Propulsion Office, Atomics International, Fermi and Hallam. Computational functions of such variables as xenon poisoning and plant efficiency represent a second simple extension of computer usage once a machine is installed. Big Rock Point is installing a digital computer for fuel-management computations with the claim that this calculation

alone can ultimately pay for the cost of the computer installation. A third function is for the computer to perform diagnostic computations. These calculations are of two kinds: self diagnosis to check that the computer is working properly, and plant-intercomparison types of calculations to check on false scrams or instrument malfunctions.

The fourth computer area is in programming. For the computer to perform its other functions, it must have available most of the detailed information and inputs from the reactor and plant. Once this information is centralized, a logical extension is to use these inputs in programming sequences, such as pre-startup checkout and automatic startup and shutdown procedures.

The ultimate function of a computer installation is full plant control. Control of minor loops such as temperature control is already common in process industries. Adaptive control of the nuclear plant is also feasible because of the large amount of input information available. It is with adaptive control that the plant can always be operated at maximum efficienty, and it is this feature that dictates the economics of computer installation.

Digitized reactor control instrumentation has been developed by Ford and G. E. Some transistorized digital logic systems for safety circuits are currently in use. The NSS Savannah's digital rod drive logic system is compared with digitized motor drives in process work. A few all-digital sensing devices for such parameters as temperature and pressure have been under development and are described.